Industrial Surveillance System Using Multiple Ultrasonic Sensors & Arm

Mr. Ramchandra K. Gurav[1], Prof. Mahesh S. Kumbhar[2]

[1]*Master of Technology. Department of Electronics & Telecommunication Rajarambapu Institute of Technology, Sakharale, M.S., India*

[2]*Asso. Prof. Department of Electronics & Telecommunication Rajarambapu Institute of Technology, Sakharale, M.S., India*

***Abstract*— In this paper we designed and implemented a Industrial surveillance system based on an embedded system with multiple ultrasonic sensor modules to enhance the system's reliability. Each ultrasonic sensor module includes a transmitter and a receiver, and the modules are placed in a line direction. The aim of this paper is to develop and implement an affordable low cost serial JPEG camera based surveillance system for remote security monitoring. User can access to their monitoring system remotely via the Ethernet with the use of Windows-based Remote Desktop program. This surveillance system consists of ultrasonic sensors and camera. When intruder detected by ultrasonic sensors, the camera will start & captures the images and save it into memory storage, after saving images these images will send on the windows based remote desktop which can be observed by user. Use of ultrasonic sensors will increase reliability of the overall system**.

***Keywords*— Embedded surveillance system, ultrasonic sensors, Windows-based Remote Desktop program**

I. INTRODUCTION

Lately the use of a surveillance system for image detection is becoming more important. An embedded surveillance system is frequently used in the home, office or factory [1] for image processing of the surveillance system [2], and also for traffic monitoring [3]-[4], but this configuration requires a high performance core, which works against some advantages of embedded systems, such as low power consumption and low cost. Some designs propose the use of different sensors to track the sequence of the human body movement [5]. Other researchers construct an external signal to trigger the embedded surveillance system by means of a PIR sensor, which is triggered when an intruder enters the monitoring area [6]. However, a PIR sensor has a high miss rate when the intruder walks at a slow speed. Hence, to solve this problem, we use ultrasonic sensors to implement an embedded industrial surveillance system. In addition, because a single receiver can be influenced by refraction and reflection, we use several sensors to receive the ultrasonic transmissions in order to enhance the reliability of the system. The objective of this paper is to design and implement a camera based remote surveillance system for remote monitoring. This surveillance system enables users to monitor their personal properties or household safety during the period when users are away from home or industry. Users can access to their monitoring system remotely via the internet using Windows-based Remote Desktop program from a personal computer.

II. SYSTEM ARCHITECTURE

Following is the block diagram of the proposed system.

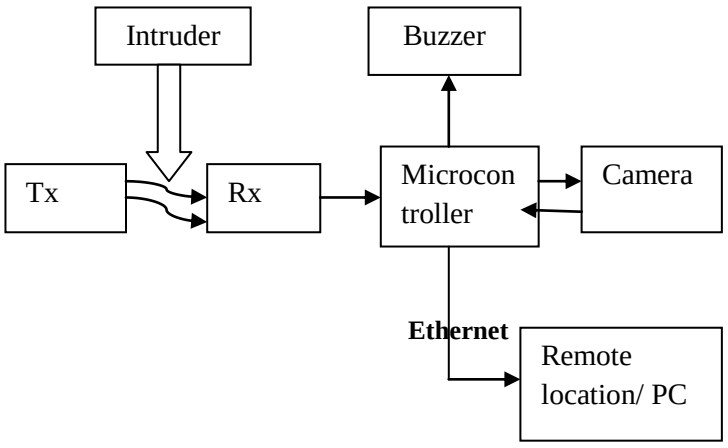

FIG.1. Proposed System's Block Diagram.

In this paper we have designed Embedded Industrial surveillance system using two ultrasonic sensors.

We have separated the transmitter and the receiver by placing them in line of sight direction. When an intruder (object) enters in the monitoring area the ultrasonic transmission will be blocked. Receiver will not receive a transmission. The embedded industrial surveillance system counts the sensing states of all ultrasonic sensors. The camera gets activated to capture the images of the intruder (object). After capturing the images, then the embedded surveillance system uploads this image to the desktop through the Ethernet. The user can then watch them on PC.

The proposed system helps to observe the images of intruder on Windows-based Remote Desktop program page even though you are not physically monitoring your company, not necessary to continue observe as like in online continuous monitoring system. The main blocks in the proposed system shown in the block diagram. We are having microcontroller, ultrasonic sensors & PC as main components of our system. In this project we are going to treat any obstacle in the ultrasonic sensors rang as the intruder.

In the above block diagram the buzzer is used for alert so when intruder is present within the monitoring area the buzzer will ON so that user can came to know that intruder is present in the monitoring room.

A. HARDWARE MODULE

FIG. 2. Actual Implemented Diagram of proposed system

As shown in the above figure we have implemented the proposed system. Basically we have to go for two modules first one is hardware module & second one is software module The hardware module mainly includes the PCB layout & manufacturing of the total board with the proper component. In the given proposed system we are using ARM microcontroller we can select any ARM depending our application & the required memory size. The ultrasonic sensor we can use of maximum range. The serial camera we have used in our system we may use the cmos camera also we have to consider the resolution and the clarity parameter of the camera when we are selecting the camera module. In the proposed system we have used ultrasonic sensor having max range i.e. 21 feet. This selection of the sensor depending on how much distance you want to monitor. Remaining components you can select on your application and requirement.

B. SOFTWARE MODULE

This basically includes the programming part of the system. The main programmes to run the overall system successfully as the program to interface the ultrasonic sensors with the microcontroller. Second is about interfacing of LCD/ADC. Once we have finished our ADC/LCD interfacing next to that we have to go for the interfacing of the serial JPEG camera which will going to capture the images. Appropriate software we can use for the programming of the microcontroller. Once we have finished all these interfacings then we have to turns towards the windows based remote desktop for that we have to write the code using visual basic (VB) language.

While doing the ultrasonic sensor interfacing you can mention proper distance in which you want to detect the intruder. You can choose any distance but it should be less than or equal to maximum range of the ultrasonic sensor that you have selected.

C. SYSTEM MECHANISM (WORKING)

In the proposed system we have used multiple ultrasonic sensors to improve sensing probability of the whole system. So when the intruder comes in our monitoring area then the ultrasonic sensors will sense this intruder once ultrasonic sensor detected the intruder then automatically our image capturing device i.e. camera will gate activate and captures the images at the same time alarm also gates fired so that we can came to know that there is something going on in our monitoring area or room.

While capturing the all images of the intruder simultaneously sends these all images on the Ethernet so that the user at the remote location can see these all images. The following flowchart will clear the actual working mechanism of the system.

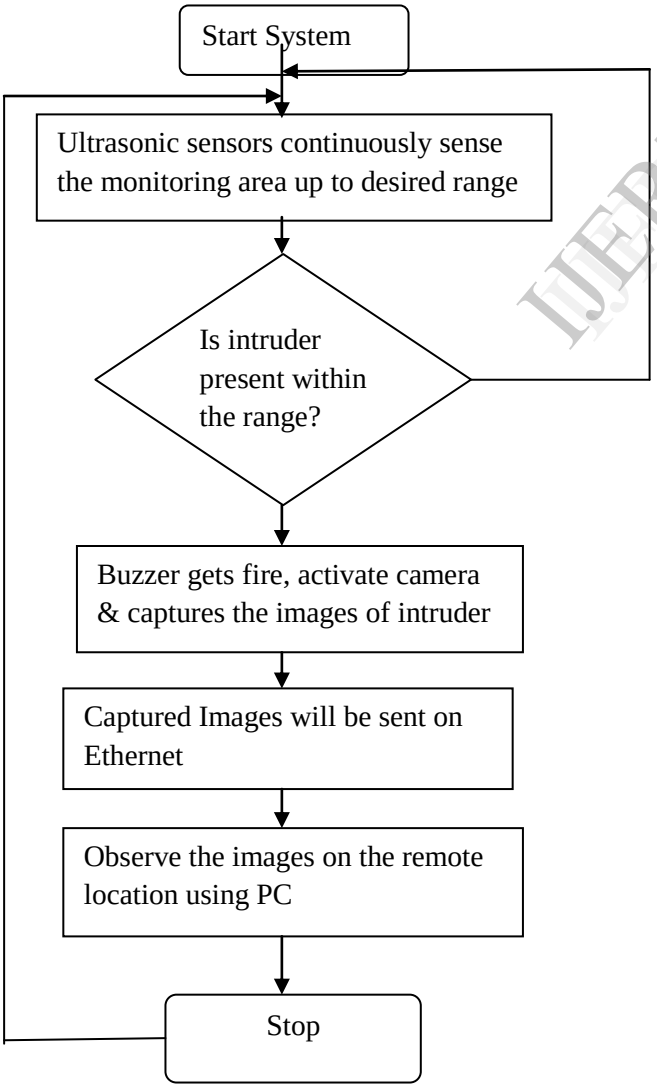

FIG .3. Flowchart of working mechanism of proposed system

The ultrasonic sensors will continuously sense the monitoring area so even the captured images observed by the user then also the ultrasonic sensors keeps going on sensing work.

III. IMPLEMENTATION RESULTS

In the experimental results, according to the specification of the components, we found that if the ultrasonic sensing distance less than 6 meters, and if we give the transmitter the same direction as the sensing direction of the receiver, the ultrasonic transmission will be blocked when an intruder enters the transmission path of the sensing area. So as explained above our design detects the intruder and turns the camera on. The scattering angle of the ultrasonic sensors is very large with a fast scattering attenuation rate. Therefore, because of our observations at different distances and with perpendicular directions, the receiver is adjusted to within 100 cm of the scattering distribution. The transmitter is aligned with the direction of the receiver.

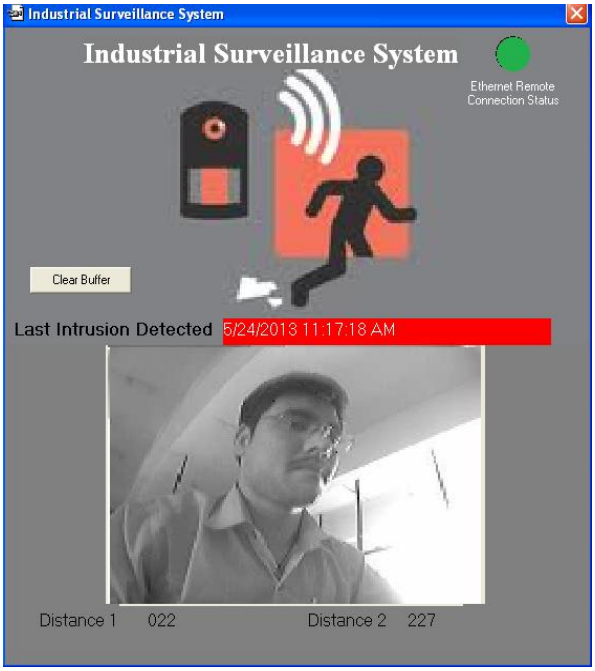

FIG. 4. Desktop window which is observed by user at remote location.

The above figure shows the output window of the desktop which is observed by the user at remote location. We have to write the program on this remote PC by using the Visual Basic language. On this output window we can observe the date & time at which the image has been captured also we can observe the distance at which the intruder was present. It has been also observed that as we are increasing the number of ultrasonic sensors the sensing probability also goes on increasing.

The table given below shows the results

Table 1. Results observed for different boud rates

Sr.No.	Image Resolution of camera	Selected Boud Rate	Time Taken To send complete image on Remote PC through Ethernet
01	160*120	115200bps	7 seconds
02	160*120	9600bps	12 seconds

V CONCLUSION

Our experiment shows that the overall sensing probability improves with the use of multiple sensors .The result is a higher cost because of the use of multiple sensors. However, the improvement of the reliability significantly reduces the occurrences of false alarm from the industrial surveillance system.

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